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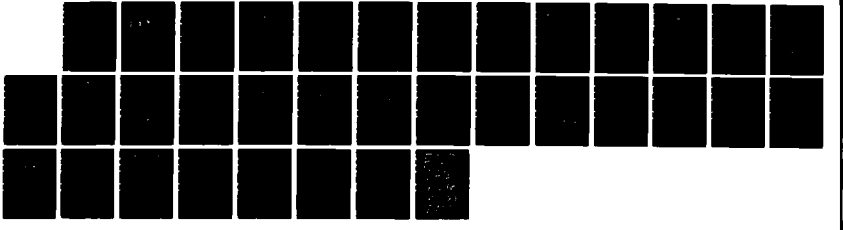

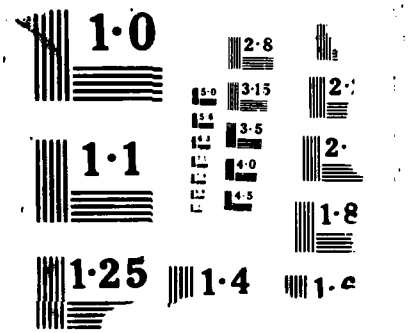
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AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

AMRAAM--THE AIR-TO-AIR "FORCE MULTIPLIER"

MAJOR STEPHEN J. ALLEN 88-0090

"insights into tomorrow"

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REPORT NUMBER 88-0090

TITLE AMRAAM--THE AIR-TO-AIR "FORCE MULTIPLIER"

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Submitted to the faculty in partial fulfillment of requirements for graduation.

AIR COMMAND AND STAFF COLLEGE
AIR UNIVERSITY
MAXWELL AFB, AL 36112-5542

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT STATEMENT "A" Approved for public release; Distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 88-0090	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION ACSC/EDC 6b. OFFICE SYMBOL (*If applicable*)	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (*City, State, and ZIP Code*) Maxwell AFB, AL 36112-5542	7b. ADDRESS (*City, State, and ZIP Code*)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (*If applicable*)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (*City, State, and ZIP Code*)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO / WORK UNIT ACCESSION NO.

11. TITLE (*Include Security Classification*)
AMRAAM--THE AIR-TO-AIR "FORCE MULTIPLIER"(U)

12. PERSONAL AUTHOR(S)
Allen, Stephen J., Major, USAF

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (*Year, Month, Day*)	15. PAGE COUNT
	FROM _____ TO _____	1988 April	31

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (*Continue on reverse if necessary and identify by block number*)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

This article provides a brief history of the Advanced Medium Range Air-to-Air Missile (AMRAAM) program to include its concept, need, capabilities, and a comparison against the AIM-7M. Also, a hypothetical combat scenario is provided to illustrate both the optimum use of AMRAAM and the potential problem areas that could limit its successful employment. Furthermore, the article suggests that support personnel and systems, as well as enhanced tactical training programs, can contribute to the effective employment of AMRAAM in combat. The article is written for the general military reader rather than just the "tactical world."

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☑ SAME AS RPT ☐ DTIC USERS	UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL ACSC/EDC Maxwell AFB, AL 36112-5542	22b. TELEPHONE (*Include Area Code*) (205) 293-2867 / 22c. OFFICE SYMBOL

DD Form 1473, JUN 86 *Previous editions are obsolete.*

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

PREFACE

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This article was written for publication. Subject to clearance, this manuscript will be submitted to Air Power Journal for consideration. The length of this article (maximum of 5000 words), the format (double spacing), writing style (geared to a general military audience), and documentation system (end footnotes) were directed by the magazine.

I would like to thank my advisor, Lt Col John Perrigo of the ACSC staff for his patience, guidance, and suggestions with this article. I also want to thank Col Robert Bryan, the Director of Armament at Eglin AFB, for his support and information. Last, but not least, I must thank my wife, Vicki, for her support, editing, and typing skills during the preparation of this article.

ABOUT THE AUTHOR

Major Stephen J. Allen was born in Des Moines, Iowa, on 7 December 1949. While attending the University of San Francisco, he enrolled in the two year USAF Reserve Officer Training Corps (ROTC) program. Commissioned a second lieutenant in 1974, he attended undergraduate pilot training at Williams AFB, Arizona, and received his pilot wings in 1975. He remained there as a T-38 instructor pilot in Air Training Command until 1979.

Major Allen's next assignment was in Tactical Air Command at Langley AFB, Virginia. There he served as an F-15 flight lead, as well as a member of the 1st Tactical Fighter Wing operations and planning staff. In April 1983, he moved to Holloman AFB, New Mexico, where he was assigned to the 479th Tactical Training Wing. He worked as an instructor pilot in the Lead-In Fighter Training program and as a Flight Commander in the 433rd Tactical Training Squadron. His last duty assignment prior to attending Air Command and Staff College was as a Tactical Assistance Field Training member in the Kingdom of Saudi Arabia. He served as an instructor pilot with the F-5 advisory team.

His accomplishments include: ROTC distinguished graduate, 1972; Air Training Command's Instructor Pilot of the Year, 1977; Tactical Air Command's Instructor Pilot of the Year (AT-38), 1984.

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"insights into tomorrow"

REPORT NUMBER 88-0090

AUTHOR(S) MAJOR STEPHEN J. ALLEN, USAF

TITLE AMRAAM--THE AIR-TO-AIR "FORCE MULTIPLIER"

I. Purpose: With the introduction of the Advanced Medium Range Air-to-Air Missile (AMRAAM) into the weapons inventory, two issues surface requiring further attention. First, the concept of tactical air-to-air employment needs modification to reflect the missile's technological advancements. Second, tactical training programs need revision to incorporate these changes.

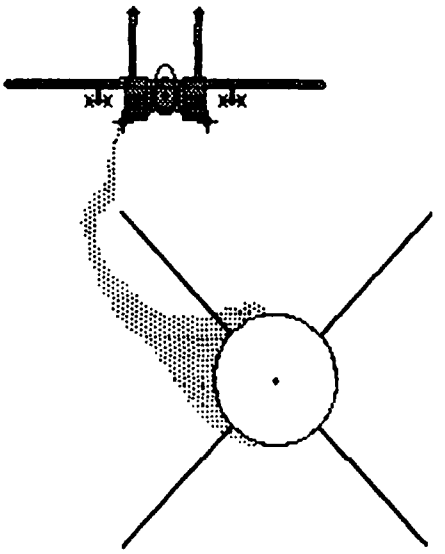
II. Problem: While AMRAAM provides unique advantages and tactical superiority, these advantages may be hindered unless employed in conjunction with and enhanced by the expertise of support personnel and systems. Furthermore, to ensure success in combat, these enhancements need to be incorporated into AMRAAM employment training programs.

III. Data: A brief history of the AMRAAM program is provided and includes its concept, need, capabilities, and a comparison against the AIM-7M. Also, a hypothetical combat scenario is analyzed to identify both the

optimum use of AMRAAM and the potential problem areas that could limit its successful employment.

IV. Recommendation: Recommend the US Air Force, Navy, and Allied Nations modify their concepts of air-to-air employment to reflect AMRAAM's technological advancements. Further recommend tactical wings develop training programs that integrate enhancements provided by support personnel and systems.

AMRAAM--The Air-to-Air "Force Multiplier"



Imagine *~ The stillness of the early morning air is shaken by a flight of four USAF F-15 Eagles taking-off on a combat mission. Their specific area defense role is to engage and destroy any enemy aircraft entering their geographical area of responsibility. No other friendly aircraft are scheduled into their zone, permitting the most liberal and offensive rules of engagement (ROE) possible--unrestricted beyond visual range (BVR) targeting and missile launch--the ROE fighter pilots hope for and missile designers envisioned. All the aircraft carry the new radar guided Advanced Medium Range Air-to-Air Missiles (AMRAAMs) and the older, yet effective, short range heat seeking AIM-9 missiles. They're armed for "bear."*

Airborne for what seemed like an eternity to the young wingmen, but only minutes in reality, the F-15's radio silence is broken by a broadcast from the experienced flight leader. He has made radar contact with multiple airborne targets. The flight of fighters turns towards the foe. All flight members acknowledge with identical contacts. The flight leader commits the Eagles against the "prey"--the aerial engagement begins! Target assignments are as previously ground briefed. Approaching lethal AMRAAM range, the targets are "radar locked."

As the range decreases and the targets enter into attack range, AMRAAMs start to "fly"! These missiles are fired well beyond visual range (BVR). The F-15's continue the attack. As the missiles near the terminal guidance distance, additional bandits are targeted, and the second "wave" of missiles are launched. Again, the bandits are still BVR. A flash on the horizon indicates one of the AMRAAMs has met its target. Then another, and another. The second "wave" of AMRAAMs close on their victims. Number Four Eagle gets a radar warning in his cockpit indicating an enemy air-to-air missile launch. He commences to evade the missile attack by maneuvering away from the bandits. Number Three Eagle follows in mutual support. Even though they have turned from the fight, their missiles still guide against their aerial foes. In the distance, the remaining twosome of F-15's see four of their adversaries desperately maneuvering their aircraft to avoid collision with the approaching AMRAAMs. The F-15 two-ship continues to press the attack. Three more missiles impact. Six of the seven bandits are now fireballs. The lone survivor jettisons his bombs. Although temporarily avoiding the peril of his flight members, he has drastically dissipated his energy and airspeed. The lead F-15 pursues and selects an AIM-9 missile to end the battle against this "sitting duck." A launch and hit! Seven for Seven--not bad. With no other bandits in the area, the flight of F-15's return to their pre-engagement location and reposition back into "hunter" formation. Successful--obviously. Seven kills; no losses; threats by enemy return missile fire successfully defeated.

Is this hypothetical combat scenario possible? Is it probable? Read on!

The "Force Multiplier"

Over a decade ago the Advanced Medium Range Air-to-Air Missile (AMRAAM) was conceived. While AMRAAM is nearing reality and full scale production is right around the corner, two issues surface requiring further attention. First, the concept of tactical air-to-air employment needs modification to reflect the missile's technological advancements. While

AMRAAM provides unique advantages and tactical superiority, these advantages may be hindered unless employed in conjunction with and enhanced by the expertise of support personnel and systems. Second, to ensure success in combat, these enhancements need to be incorporated into AMRAAM employment training programs.

This article provides:

- A brief history of the AMRAAM program. This includes initial concept, need, capabilities, and a comparison against the AIM-7M (the current medium range air-to-air missile).
- A discussion of who benefits from the introduction of AMRAAM into the weapons inventory.
- A review of the introductory hypothetical "best situation" combat scenario examining the optimum use of AMRAAM in the combat arena.
- Potential restrictions and limitations to the "best situation" scenario.
- A discussion of the items enhancing the tactical situation and the employment of AMRAAM.
- Considerations for tactical training that would enhance combat capability.

In the Beginning...

In 1976 a document entitled "Joint Service Operational Requirements for an Advanced Tactical Air-to-Air Missile" was published. The study, written by Air Force and Navy pilots, maintenance, logistics, and supply

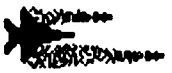
officers, discussed the operational problems associated with air-to-air weapons employment during the Vietnam war. It also addressed and identified the requirements for an advanced technology missile to replace the existing and relatively ineffective AIM-7 Sparrow missile.[1]

The document identified six major requirements for the future AMRAAM. The missile had to be:[2]

- Able to guide on a target with a high probability of kill while operating in all weather conditions and electronic countermeasure (ECM) environments. This requirement was first and foremost!
- Easy to use and universally adaptable to all front line fighters.[3]
- Capable of "launch-and-leave"[4], thus providing a fighter the opportunity to maneuver against enemy air and ground threats.
- Lighter than the AIM-7 Sparrow allowing a fighter to carry an increased number of missiles.
- Easily maintainable with a high degree of reliability.
- Affordable.

From this initial concept, the joint US Air Force/Navy and NATO project came to life.[5] In December 1981, Hughes Aircraft Co.[6] was awarded the contract for full scale development of AMRAAM. Although it has been a bumpy road with cost overruns and production delays,[7] the AMRAAM (now officially labeled the AIM-120a) program is now proceeding successfully through the flight test and evaluation phase.[8] Full scale production and delivery should commence in early 1989.[9]

The Need--why AMRAAM?



Given the problems associated with the AMRAAM program and the expense of each missile,[10] why has it become one of the DOD's top priority weapons programs?[11] In an effort to neutralize the Soviets' overwhelming numerical superiority in combat aircraft and their development of more sophisticated high-performance fighters,[12] the Air Force concluded the "cheapest" means of countering this threat relied on maintaining a "technological superiority [weapons and aircraft] as a force multiplier."[13] General Russ, Tactical Air Command's Commander, considers ". . . AMRAAM the most important tactical weapon currently under development," for it provides a fighter with the capability to fire at multiple targets on a single pass, as well as the ability to launch-and-leave.[14]

Faced with congressional opponents who believe a modified AIM-7 missile would be sufficient to counter the existing Soviet threat, General Russ has stated "'It's [modified AIM-7 Sparrow] a pretty good idea, but it's only a minor modification to an existing system. It doesn't give us [tactical air forces] what we need.' Such a modified version of the Sparrow, he asserted, lacks an active radar seeker and is no match for the launch-and-leave, multiple-target, and improved electronic countermeasures of AMRAAM."[15] He further contends the quantum leap in technology and capability of AMRAAM over the modified Sparrow

justifies the extra $200 million (for AMRAAM vice improved AIM-7), given a total program outlay of $7.2 billion![16]

In addition to the "nominal" cost difference between the AMRAAM and the modified AIM-7, AMRAAM provides the F-16 with its first all weather BVR missile capability (the Sparrow is incompatible with the F-16). AMRAAM was specifically designed to meet the "strict weight limits in order to be compatible with the F-16's wingtip missile stations."[17] This directly contributes to the tactical air forces "force multiplier" concept by the simple fact that additional US and NATO aircraft will be capable of employing AMRAAM.

Looking ahead, the Advanced Tactical Fighter (ATF) armed with AMRAAM as its primary weapon, will provide the Air Force with both a technological advantage and the capability to meet the threat for the foreseeable future.[18]

Given the threat, technological sophistication, added fire power, and the future development of fighter aircraft, AMRAAM became the logical follow-on missile choice.

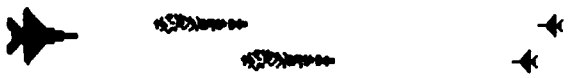
Capabilities and Comparisons

AMRAAM has numerous significant improvements over the Sparrow. As mentioned earlier, AMRAAM has the capability to launch-and-maneuver due to an active radar seeker head and inertial midcourse guidance system. This enables a fighter to target and fire on multiple

enemy aircraft during a single pass, even in an ECM environment. No longer will the fighter be required to continually "illuminate" the target with its radar until missile impact as is currently the case with the Sparrow. With nearly twice the effective range coupled with greater velocity than the AIM-7, AMRAAM significantly increases the distance between attacker and target at missile impact (F-Pole). Additionally, it weighs approximately 180 pounds less, allowing each fighter to carry an increased weapons load.[19] Finally, like its predecessor, AMRAAM has the ability to launch beyond visual range (BVR) in all weather conditions, with look down/shoot down capability--only better.[20] (See Figure 1-1 for Characteristic Comparison: AIM-120a and AIM-7M)

Interpreting these differences, what advantages does AMRAAM have over the present Sparrow? The most obvious is multi-targeting. A fighter armed with AMRAAM can target and fire on numerous enemy aircraft, at longer ranges, therefore increasing its offensive potential. By doing so, our fighter faces fewer enemy aircraft at the "merge",[21] thus increasing survivability against remaining enemy aircraft. This feature also allows the fighter to launch-and-maneuver against additional aircraft formations and/or ground threats. Furthermore, the increased range of AMRAAM allows us the first missile shot. This is not only tactically advantageous for us, but psychologically devastating to the enemy.[22] Additionally, due to the AIM-120a's active radar seeker head, it can be used effectively with a degraded aircraft radar system.[23] Finally, AMRAAM provides a higher probability of kill against aircraft using electronic jamming systems. In a computer simulated combat scenario, AMRAAM was pitted against the

AIM-7 using similar aircraft. AMRAAM's performance was vastly superior. According to General Thomas Fergusion, AMRAAM program manager, aircraft utilizing AIM-120a "stayed outside the lethal range of the Sparrow missile in almost every scenario."[24]



Who Benefits...

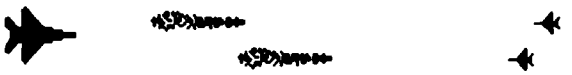
The most obvious to benefit from AMRAAM is the fighter pilot. Not only does he have increased fire power and probability of kill against enemy aircraft, but more importantly AMRAAM presents him with a higher degree of survivability. But the fighter pilot is not the only one who benefits.

On the maintainer's side of the house, AMRAAM will be welcomed with open arms. Its technology presents no significant differences over the AIM-7 in deployability, buildup, or maintenance. In fact, it's more durable and more reliable.[25] Additionally, it's simpler to ready for combat use! "All that's necessary to get the system operational is to pull it from the container, slap wings and fins on it, and to run it through a built-in tester."[26]

The theater commander also benefits. The introduction of AMRAAM to his air-to-air weapons arsenal increases the offensive firepower of his fighter forces. AMRAAM provides the "force multiplier" to challenge and defeat numerically stronger adversaries. Given the increase in "killing" power and survivability, air-to-air and air-to-ground missions will have

a higher probability of achieving their objectives while minimizing losses. Additionally, the corresponding increase in combat capability does not require added manpower support, beddown facilities, equipment, or airlift. Current deployment packages will remain unchanged.[27] The commander simply gets more "punch" from the same resources.

The "Best Situation"



At the beginning of this article, a hypothetical scenario illustrated the use of AMRAAM in a combat environment. Although the scenario is hypothetical, it is quite possible under optimum conditions.

Reviewing the engagement identifies the following benefits gained when AMRAAM is used in an optimum unrestricted environment. First, the F-15's initiated the first shots of the battle. Second, both "waves" of missiles were launched BVR on a single pass providing them with a "force multiplier." Third, as the engagement closed to the merge, the adversaries were more concerned with defensive reactions than their primary mission--bombs were jettisoned thus keeping our facilities safe from aerial attack. Fourth, even though the F-15's received return missile fire, the ability to launch-and-maneuver nullified enemy effectiveness. At the same time, the AMRAAMs continued to guide to their targets, even after the F-15's evasive maneuvering and reversal from the fight. Fifth, AMRAAM cleared the way for an advantageous entry to the merge. While outnumbered at the start of the engagement, AMRAAM

eliminated adversaries at range so the F-15's faced fewer enemy aircraft in close combat. Finally, while an AMRAAM could have been used to down the "fleeing" bandit, the obvious advantage of the F-15s situation afforded them the luxury to select the "cheaper" AIM-9, saving their AMRAAM's for combat situations requiring its unique and superior capabilities.

But will these conditions always exist? Probably not. Then what conditions could limit this "best situation?"

Limitations to the "Best Situation"

Lets step through this hypothetical scenario and identify what "monkey wrenches" could be thrown into the situation limiting the optimum use of AMRAAM.

Rules of Engagement (ROE): ROE providing unrestricted engagement against known hostile targets is the obvious optimum situation. Unfortunately its likelihood is somewhat questionable! Politics and theater commanders may place restrictions to the ROE limiting the "force multiplier" ability of AMRAAM. In Vietnam, aircrews were obliged to visually identify adversary aircraft prior to clearance to fire, even though there were electronic means of identifying friendly and enemy aircraft.[28] Even though identification means have made quantum improvements since Vietnam, political restrictions may still be a plaguing factor. Additionally, theater commanders may further restrict politically approved ROE.

In August 1981, the US Navy conducted a Freedom of Navigation Exercise in the Gulf of Sidra, off the coast of Libya. Peacetime maritime ROE providing the right of self-defense were in effect. These rules "authorize armed response to three forms of a threat: an actual use of force, or hostile act; an imminent use of force; and a continuing threat of use of force." [29] After several incidents of harassment by the Libyans, two Libyan Su-22 Fitters penetrated the exercise area. Two Navy F-14's were tasked with intercepting the intruders. After repeated requests by the aircrews for permission to fire, they were commanded not to fire even though the Fitters were threatening with an "imminent use of threat." The F-14's were only given permission to fire after the Fitters had first launched an air-to-air missile at them.[30] Fortunately the missile missed, and the F-14's proceeded to down both of the Soviet built Fitters.

Therefore, political and commander constraints may play a significant factor in the optimum employment of AMRAAM in the combat arena.

Presence of friendly aircraft: It would be somewhat naive to assume only four friendly aircraft airborne at any given time. This would be especially true if the conflict included joint forces from the other services, as well as other allied nations. There may be further complications. Namely, adversary forces may possess and fly American or friendly nation built aircraft. Therefore, not only identifying enemy aircraft type, but also its origin may likely be required prior to missile launch.

Requirement for enemy/friendly aircraft identification: As mentioned above, aircraft identity may be required to distinguish between friendlies

and adversaries. Present technology enables this within a reasonably high degree of reliability and is continually improving.[31] But there may be problems! Ambiguities from a degraded aircraft system could falsely mislead the attack pilot and cause a misidentification. Additionally, close proximity of friendly and enemy aircraft may produce a degree of unreliability, again misleading or confusing the pilot. The obvious--positive aircraft identification is paramount.

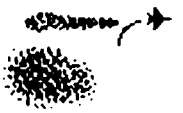
Degraded systems: For a "technologically superior" aircraft and weapons system to operate as designed, their systems must function at near peak performance. Anomalies, system ambiguities, and "hard breaks" caused by maintenance and supply problems render a superior system inferior. Without a fighter's eyes (radar), its brain (avionics and weapons control systems), its muscles (missiles), and its strength (propulsion), a fighter and its armament are nothing more than the "largest bird in the sky to be plucked." Therefore, expert maintenance and supply support are critical for AMRAAM in achieving and maintaining its "force multiplier" status.

Aircraft armament: It would obviously be advantageous for all aircraft to be armed with the most sophisticated and superior armament available when confronted with an adversary in combat. Unfortunately this may not be the case! Like any new system, initially there will limits in the number of missiles available. Planned production of AMRAAM is scheduled at 3000 missiles per year.[32] Depending how soon a conflict arises after the introduction of AMRAAM to the inventory, will determine whether all, some, or any of the fighters will be armed with it. There

may be a requirement for flight members in a given formation to fly with different missile armament configurations: some may be armed with the AIM 120a's and others with AIM-7's. This would obviously change the offensive capability of the flight, as well as the launch-and-maneuver concept of those aircraft carrying missiles other than AMRAAM.

Aircrew training: The scenario depicted each flight member performing with the skill, ability, and keenness of a Steve Canyon! Experience has shown there may be a large gap between the abilities of a seasoned and experienced flight leader and the new, rather inexperienced wingman. While this is true with any weapon system, it is a critical issue with AMRAAM employment. If AMRAAM equipped aircraft are expected to meet the challenge of numerically superior adversaries and intensity of future air battles, every flight member will have to perform at peak levels of performance. Realistic aerial combat training can provide the link. More on this later.

While these problems may hinder the optimum use of AMRAAM, other people and systems can make the difference!



Enhancements to Employment

The preceding section identified possible limitations to AMRAAM's employment. These problems are not insurmountable, but do require further attention.

Rules of engagement must be thoroughly thought out and examined prior to launching our fighter forces. Restricting the use of AMRAAM to

other than the way it was designed and conceptualized is like sending a prizefighter into the ring with one hand tied behind the back. Politicians and the military hierarchy must provide a combat environment allowing the unrestricted use of the "force multiplier" so fighter resources and men are not jeopardized unnecessarily.

The presence of other friendly aircraft in a combat arena is an important issue when considering BVR offensive weapon operations. To minimize the requirement and burden for positive aircraft identification, airspace coordination plans require review and modification to provide the maximum use of BVR "free fire" zones. This gives AMRAAM equipped aircraft an optimum operating environment--namely, "if it flies, it dies." Additionally, air tasking orders can be written to deconflict opposing air-to-ground and air-to-air missions. When conflicts are unavoidable, planners must establish easily understood safe recovery procedures so airborne air-to-air fighters can readily identify returning strike mission aircraft. Of course, all of these considerations are considerably more complicated when combined with concurrent allied operations.

Closely related to the physical presence of friendly aircraft is the requirement for positive aircraft identification. While onboard aircraft systems can be used to provide autonomous operations, redundant and alternate sources are required to assist in the elimination of problems previously mentioned (i.e. misidentification, an enemy flying friendly nation produced aircraft, etc.) Other radar and control units, such as Ground Controlled Intercept (GCI) sites, Airborne Battlefield Command and Control Centers (ABCCC), and Airborne Warning and Control System

(AWACS) aircraft, can provide or pass valuable information to the fighter pilot. This is especially true with AWACS. Their advanced long range radars can locate and identify airborne threats beyond the range of the fighters radars. Depending on their location, they can search inside enemy territory with their look-down radars and "tag" enemy aircraft from origin.[33] This information can be transmitted over jam-resistant radios[34] to fighters enhancing situational awareness, enemy identity, and target selection.

Although presently on "hold"[35], another possible enhancement in AMRAAM employment will be with the introduction of Joint Tactical Information Distribution System (JTIDS). This system "makes it possible to disseminate battle management information instantly to all users on the ground and in the air."[36] This antijam system of digital communication[37] would obviously eliminate some of the problems discussed earlier, for ". . . commanders [could] inform operators about the location of both friendly and enemy forces, ingress and egress corridors, and targets."[38]

The items discussed are by no means an all inclusive list, but they do provide enough information to realize AMRAAM employment can be enhanced by the expertise of other personnel and systems. Also the corollary is true; AMRAAM employment may be hampered without them.

To make this coordination of people and systems work together, in a unified effort to accomplish the mission, all must practice and train together.

Tactical Training

Like complicated pieces of machinery which require all of its' parts to perform correctly and in harmony to function properly, tactical air-to-air employment and especially AMRAAM employment, are no different. All of its parts, for example the pilot, flight line mechanic, avionics specialists, and radar controllers (to name only a few), will contribute and enhance the effective use of this weapon system. But this machinery doesn't magically happen. It takes lots of training and practice!

Each unit can easily train on its own to learn basics, but the "razor's edge" is developed and maintained with team training. The old adage, "train like you're going to fight" is a truism, especially when the effectiveness and success of the mission depends on the combined efforts of various agencies. AFM 1-1 states;

> Sound military judgement and historical experience dictate the importance of educating and training forces in the way they intend to fight. . . . To ensure the readiness of our forces, commanders must develop and implement training programs that build required warfighting skills and that simulate, as closely as possible, the combat environment in which we expect to fight. This means training in simulated combat situations that impose the operational realities of degraded command, control, and communications; adverse environment conditions; and intense physical and electronic enemy threats.[39]

Major tactical exercises, like Red Flag at Nellis AFB and Maple Flag in Canada, can provide the environment and threats for the most realistic training possible for AMRAAM employment. Unfortunately, this type of

training is limited. Consequently, tactical fighter wing level training programs must fill the gap.[40]

Wings will need to develop training programs for their AMRAAM fighter forces that provide and emphasize:

- Training missions where few friendlies are pitted against many adversaries, therefore exercising and practicing the "force multiplier" capabilities of AMRAAM employment.
- Scenarios where some aircraft in the same flight are armed with AIM-120a and others only with the AIM-7, simulating limited AMRAAM resources.
- Missions that simulate less than optimum employment conditions This should include scenarios which incorporate restrictive ROE, degraded modes of systems operation, VID requirements, etc.
- Extensive use of AWACS and GCI in routine training. This type of training not only benefits the pilots in the fighters, but also the weapons controllers on the radar scopes. Both can gain awareness of each other's capabilities, limitations and requirements.
- Continued use of Air Combat Maneuvering Instrumentation (ACMI) as a tool in evaluating performance in the employment of AMRAAM. This electronic method of recreating the aerial engagement provides an excellent means for debriefing each flight member's actions, communications, successes, and failures.
- Flight simulator profiles duplicating conditions that cannot be practiced in flight training (i.e. surface to air threats, radar warning of enemy aircraft, etc.)

• Aircraft sortie surges that puts the maintainers under the "gun" to generate wartime sortie rates, while at the same time demanding peak operational aircraft and weapons systems conducive to optimum AMRAAM employment.

The "Bottom Line"

AMRAAM, the missile of the future, is right around the corner. It provides a "force multiplier" enabling our tactical air forces to effectively combat the numerically superior fighter forces of the Soviet Union. While AMRAAM technological advancements and superior capabilities provide a unique advantage to our fighter forces, its optimum employment may be hindered without the expertise provided by other personnel and systems. For this coordination of people and machines to harmonize and attain the "razor's edge" in combat capability, training programs need to be developed. These training programs must exercise the entire spectrum of activities associated with AMRAAM employment.

CHARACTERISTIC COMPARISON: AIM-120A AND AIM-7M

CHARACTERISTIC	AMRAAM	Sparrow
Dimensions:		
Length (Feet)	11.7	12.0
Diameter (Inches)	7.2	8.0
Fin Span (Feet)	2.4	3.3
Weights:		
Launch (Lbs.)	335.0	510.0
Payload (Lbs.)	50.0	90.0
Performance:		
Speed (Mach No.)	4.0	2.5
Range (Nautical Miles)	40.0	24.0
Altitude (Feet)	40,000.0	70,000.0
Guidance:		
Type:	Inertial Midcourse/ Active Radar Terminal	CW- Semi-Active Radar

FIGURE 1-1

Data extracted from: U.S. Missile Data Book, 1987 (11th Edition), Data Search Associates, 1986, 2-9, 2-89.

AMRAAM—The Air-to-Air "Force Multiplier"

NOTES

1 Walt Lang, "AMRAAM-," *National Defense*, July-August 1987, 53.

2 Ibid., 53-54.

3 Brian Wanstall, "Fire and Forget--Prime need for 1990's Air Combat," *Interavia*, 3/1987, 241. US aircraft initially planned to carry AMRAAM are the USAF's F-15 and F-16, as well as the Navy's F-14 and F/A-18. Additionally, NATO aircraft scheduled to carry them are the German F-4F, British Tornado and Sea Harrier, and the Eurofighter.

4 "Launch-and-leave" is now a passe term in the tactical world. "Launch-and-maneuver" is the current terminology, but for all intents and purposes holds the same in meaning.

5 Wanstall, "Fire and Forget--Prime need for 1990's Air Combat," 241. A 1980 NATO Memorandum of Understanding between the US, Germany and United Kingdom provided ". . . that AMRAAM be developed by the USA and that an Advanced Short-Range Air-to-Air Missile (ASRAAM), to replace Sidewinder [AIM-9], be developed in Europe, avoiding duplication of development, improving interoperability and contributing to reduced costs. Germany and the UK will buy AMRAAM, and ASRAAM will be bought and tested by the USA. Both can be coproduced in Europe and the USA. Each side is represented in the other's development program and there are arrangements for industry-to-industry technology transfer."

6 Ibid., 242. Raytheon Co. is now a second-source contractor, producing 75 of the first 180 missiles built in Lot 1 of production (FY 1987).

NOTES--CONTINUED

7 Major John R. Pinnel, "A History of AMRAAM: The Search for the Air-to-Air Missile of the 1990's" (Unpublished paper, Air Command and Staff College [ACSC], Maxwell AFB, Al), 30-34. In November 1983 projected completion schedule dates, technical, and budgetary problems surfaced. This led to numerous technical revisions and a slip in the development schedule by two years.

8 LTC Charles Parda, USAFHQ/XOORE, per telecom 9 Nov 1987. As of 22 Oct 1987, AMRAAM has accomplished 48 of the programed 90 live fire tests. 38 test shots were successful (8 unsuccessful and 2 no launch.) Test conditions have varied and included: look-down/shoot-down; jamming targets; multiple targets; over water firings; and various combinations thereof.

9 Ibid. Final test shots are scheduled for December 1988.

10 Ted G. Nicholas, *U.S. Missile Data Book, 1987 [11th Edition]* (Fountain Valley, California: Data Search Associates, 1986), 2-10. The flyaway cost of AMRAAM is approximately $436,000 each.

11 James W. Canan, "The Issues," *Air Force Magazine*, October 1986, 46-49.

12 Edgar Ulsamer, "Progress, Priorities, and Fantasies," *Air Force Magazine*, January 1986, 88. The Soviets Mig-29 and Su-27 are high performance fighters with similar thrust-to-weight, maneuverability, and weaponry as current USAF first line fighters.

13 Ibid., 88.

14 Ibid., 89.

15 Ibid., 89.

16 Ibid., 89. Costs are listed in 1985 dollars. (Nicholas, in *U.S. Missile Data Book, 1987 [11th Edition]*, 2-10, lists total flyaway AMRAAM package as $10.65 billion.)

NOTES--CONTINUED

General Russ also states that, "Nobody is arguing about the need for AMRAAM, just about its costs."

17 Bill Sweetman, "Against the Odds--Air-to-Air Combat in the 1990's," *International Defense Review*, 5/1987, 583.

18 Ulsamer, "Progress, Priorities, and Fantasies," 88.

19 Ibid., 583. Example--The normal F-15 armament configuation is four radar (AIM-7) and four heat seeking (AIM-9) missiles. AMRAAM can replace the AIM-9's on the wing mounted launcher rails, as well as the AIM-7's, giving the Eagle the capacity to carry a total armament load of eight AMRAAM's.

20 Nicholas, *U.S. Missile Data Book, 1987 [11th Edition]*, 2-10, 2-89.

21 Merge--A term used to describe a point in the sky where enemy and friendly aircraft are in close proximity.

22 Sweetman, "Against the Odds--Air-to-Air Combat in the 1990's," 582. BVR missile shots destroy hostile aircraft at longer ranges therefore improving the fighters odds prior to close range engagements. Additionally, BVR shots disrupt enemy formations and their mission objectives, while at the same time limiting return missile fire.

23 Ibid., 583. AMRAAM can be fired without onboard radar assistance if fired within the active radar seeker head range of the missile.

24 Ibid., 583.

25 Lang, "AMRAAM-," 55. AMRAAM has been referred to as the "wooden round" due to the fact that it can survive years of storage and the rough use while onboard a fighter aircraft. Additionally, when exposed to saltwater corrosion and the by products of engine combustion, the missile still performs.

26 Ibid.,55.

NOTES--CONTINUED

27 An interesting footnote--When the ATF (Advanced Tactical Fighter) enters the inventory with AMRAAM as its primary armament, manpower support and airlift requirements to support a typical fighter deployment will actually be reduced. Compared to the F-15, an ATF squadron will require two-thirds fewer maintenance specialists and one-third decrease in total manpower requirements due to the quantum improvements in technology.--General Robert D. Russ, USAF, Commander Tactical Air Command, "Spreading the Firepower, Extending the Battlefield," *Air Force Magazine*, April 1987, 72-73.

28 Robert R. Ropelewski, "Antiquated Rules of Engagement," *Aviation Week & Space Technology*, 1 June 1987, 11.

29 Colonel W. Hays Parks, Chief of International Law, Department of the Army, "Crossing the Line," *Proceeding* (U.S. Naval Institute), November 1986, 129.

30 Parks, Lecture on "Law of Armed Conflict," USAF Air Command and Staff College, 23 November 1987.

31 LTC Buzz Mosley, USAFFWS/COFE, per telecom 2 Oct 1987.

32 Nicholas, *U.S. Missile Data Book, 1987 [11th Edition]*, 1-6. Production rate of 250 missiles per month. Total missile package--24,337. (USAF--17000+ and USN 7000+). Production completion is scheduled for 1996.

33 Donald J. Alberts, "Air-to-Air Tactics, Technological Change, and Future Fighters," *Military Technology*, 3/87, 86-87.

34 John T. Correll, "Thirty-Seven Wings of the Best," *Air Force Magazine*, April 1987, 46. All tactical aircraft in the USAF are equipped with Have Quick radios allowing clear line-of-sight transmissions, even in a jamming environment.

35 Sweetman, "Against the Odds--Air-to-Air Combat in the 1990's," 586. The USAF has deferred plans to put JTIDS in the F-15 until the display of information can be made more comprehensible to the pilot. Additionally, USAF F-15 JTIDS Class 2

terminal that provides both jam-resistant channels for data and voice communications has been canceled due to budget constraints.--Annual Report to the Congress, Fiscal Year 1988, Caspar W. Weinberger, Secretary of Defence, 1 January 1987, 198.

36 Edgar Ulsamer, "The Vast Potential of Tactical Technology," *Air Force Magazine*, April 1987, 54.

37 James W. Canan, "Electronics for the High Ground," *Air Force Magazine*, July 1987, 50.

38 Ulsamer, "The Vast Potential of Tactical Technology," 55.

39 Air Force Manual 1-1, *Basic Aerospace Doctrine of the United States Air Force*, Department of the Air Force, 16 March 1984, 4-7.

40 Colonel Clifford R. Krieger, USAF, "Fighting the Air War: A Wing Commander's Perspective," *Air Power Journal*, Summer 1987, 29. A firm believer in realistic training, he warns it "must not be so costly that it prices itself out of existence." Therefore, training "must be both realistic and safe."

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